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None

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(54) Drilling fluid composition

(57) The invention relates to a drilling fluid composition in which a water soluble glycol ether is maintained as the continuous phase of an emulsion by the action of a brine composition emulsified into the glycol ether by suitable surfactants.

The glycol ether is chosen to show substantial solubility in sea water or fresh water such that upon disposal of the drilling fluid or coated drilled cuttings the emulsion ether phase will resolubilise and be removed from the immediate environment.

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DRILLING FLUID COMPOSITION

This invention relates to a fluid composition useful for the drilling of wells.

Drilling fluids are circulated down a wellbore during well drilling operations. The fluid is usually pumped down a central drillstring, passes through the drill bit into the wellbore and then returns to the surface.

The fluid is then recovered, solid materials extracted, processed and reused.

Drilling fluids are required to remove rock cuttings generated during the boring process, to lubricate and cool the drill bit and maintain the integrity of the hole.

Physical properties of the drilling fluid such as viscosity, density, salinity, filtrate loss may be modified by chemical addition as necessary.

One major problem which occurs in the use of water based fluids as drilling muds is the hydration of rock being drilled which is particularly acute when the interval contains clays and shales.

These materials exhibit a great affinity for water and adsorption leads to swelling of the rock with resultant stresses leading to collapse of the borehole or loss of structure.

Such failures lead to wellbore expansion, stuck pipe, excessive rheology, and general drilling problems.

A second problem with water based mud which is particularly prevalent in the North Sea is the drilling of so called "salt stringers".

These intervals comprise regions of high concentrations of water soluble salts such as sodium, magnesium and potassium chloride which will dissolve in the drilling fluid and lead to hole enlargement, wash out and general failure of the wellbore.

One solution to the above problems has been the use of so called "salt saturated" solutions in which a soluble salt, usually sodium chloride is dissolved at maximum concentration in the aqueous medium and used as the drilling fluid base.

Such solutions limit shale hydration and prevent further dissolution of drilled salts into the fluid.

However, salt saturated solutions are expensive, have limitations on the density range which may be used and limit the number of additives which may be used to control the mud properties.

A second and more widely applied solution involves the use of oil based drilling fluids which are usually formulated with mineral oils.

These fluids comprise a brine phase which is tightly emulsified into an external oil phase by the use of suitable surfactants.

Oil based drilling muds therefore present an inert oil phase to the surface of drilled rocks which will not hydrate shale nor dissolve salt.

Oil muds have a much wider range of density, rheology, thermal stability and application than salt saturated or water based mud and are greatly used.

Cuttings recovered from oil based muds are covered with a thin film of oil which prevents hydration and breakage.

However, disposal of rock cuttings which contain a significant proportion of water insoluble oil especially by disposal through marine dumping at the drill site is becoming environmentally unacceptable.

Other additives have been used to attempt to control the shale hydration of water based muds such as potassium chloride, polyacrylamide, polyglycerols, carboxymethyl derivatives, gilsonite, calcium chloride and sodium silicate.

However, none of these systems have proved to match the performance of oil mud and importantly have minimal effect in preventing solution of salt sections.

There exists a need for an environmentally acceptable alternative to oil mud which exhibits control of both shale hydration and salt dissolution and which may be used over the density range covered by oil mud systems.

According to the present invention there is provided a drilling fluid comprising a composition which contains a sea water soluble organic ether compound, emulsifier surfactant content, and a brine content which lead to an emulsion in which the ether compound is the continuous phase of the resultant emulsion and is essentially insoluble in the brine phase.

Advantageously the ether compound is chosen to prevent hydration of clay minerals, will not dissolve drilling salt sections but will dissolve in low salinity fluids such as sea water.

Thus the drilling fluid may be used to drill through water sensitive rocks but upon disposal either as whole mud, or as a coating on removed cuttings the ether compound may be removed by washing or will redissolve upon disposal to the marine environment and degrade by natural processes.

The invention therefore provides for a novel water soluble fluid, of improved environmental acceptance which acts in the manner of an oil mud as the formulated system but is readily removed from drilled material.

Examples of water soluble ethers which may be used as the component of the drilling fluid include polyalkylene glycols such as polypropylene glycol, mixtures of ethylene/propylene oxide polymers, butyl glycol ethers, ethoxypropoxypropanol, phenoxyethanol and associated polyglycol ethers.

The structure of the ether components especially suitable for use in the invention may be described as:

$$R[(-OC_2H_4)_n(-OC_3H_6)_m(-OC_4H_9)_p-OH]_r$$

where R may be an alkyl grouping, alkylaromatic, alkoxide group, substituted alkyl, alkylaromatic or substituted aromatic function, n & m may take values of 0 to 10 and r will be an integer from 1-3.

In general the ethylene oxide content/propylene oxide content is adjusted to ensure adequate solubility in fresh water or sea water. At a temperature of 0-30°C this should result in a solubility of at least 10% by volume glycol ether in sea water.

The ether component may be used at an ether/water ratio varying from 30/70 to 95/5 in a similar manner to oil mud.

Other additives known to those skilled in the art of mud formulation such as organoclay viscosifiers, fluid loss additives, weighting agents such as barite, haematite etc. may also be included in the system.

An essential component of the fluid is a dissolved salt content which results in insolubility of the ether fluid. Typically this may be calcium, sodium, potassium chlorides or other water soluble salts.

Preferentially calcium chloride solution is used as the brine phase.

A further essential component is a surfactant content which emulsifies the brine phase into the insolubilised ether and may typically be an organic acid, amide, ethoxylate, amine, phosphate or combination thereof.

The invention will be described by reference to the following examples.

EXAMPLE 1

A drilling mud emulsion in which a sea water soluble glycol ether comprises the external phase of the mud formulation is produced by mixing the following in order on a Silverson blender:

166.0 ml	EDP (glycol ether ex BP Chemicals)
0.8 g	Klucel H (hydroxypropyl cellulose ex Aqualon)
3.5 g	Calcium oxide
15.0 ml	PB82 (polyacid ex Union Camp)
3.0 ml	Bitran H (imidazoline ex ABM Chemicals)
166.0 ml	25% calcium chloride solution

Mixing is continued until a stable emulsion results giving a glycol ether phase/water ratio of 55/45.

Mud properties were measured on a Fann 6 speed rheometer at 38°C (100°F) to give the mud values:

Apparent viscosity	101 cP
Yield point	40.3 Pa (84 lb/100 sq.ft.)
Plastic viscosity	59 cP
Gel strength	9.6/13.9 Pa (20/29 lb/100 sq.ft.)

The results demonstrate the formation of a drilling fluid emulsion of rheology suitable for drilling purposes.

EXAMPLE 2

5 g of sodium bentonite sieved to 1-2 mm particle size was placed in 50 g of the fluid produced in Example 1, and stored at 90-95°C in an oven for 16 hours.

The sample was then removed, sieved through a 1 mm mesh screen and the extracted bentonite particles washed clean in a 10% solution of potassium chloride.

The recovered solids were then dried at 90-95°C and reweighed.

Allowing for moisture content of the original material the percentage recovery of unchanged particle size bentonite was then calculated and is a measure of the inhibitive property of the fluid in preventing hydration of the bentonite clay.

The same procedure was used to compare the performance of sea water, a 50/50 oil mud emulsion, a bentonite/PAC gel mud and KCl/polyacrylamide blend which are all typical drilling fluid systems.

The results obtained were:

Drilling Fluid	% Bentonite Recovery
Sea Water	12
Bentonite/PAC	28
KCl/Polymer	60
50/50 Oil mud	95
Fluid of Example 1	100

The results show that the fluid in Example 1 is highly inhibitive to clay materials giving better performance than a standard oil mud system and all conventional water based fluids.

EXAMPLE 3

A drilling mud emulsion in which a sea water soluble glycol ether comprises the external phase of the mud formulation is produced by mixing the following in order on a Silverson blender:

100 ml	P400 (400 mol. wt. polyproylene glycol ex Dow Chemicals)
15 g	Perchem DMB (organoclay gellant ex Akzo Chemicals)
8 ml	Bitran H (imidazoline ex ABM Chemicals)
100 ml	25% Calcium chloride solution
2 ml	Unitol AC (tall oil fatty acid ex Union Camp)

Mixing is continued until a stable emulsion is produced with the polypropylene glycol as the external continuous phase and the following properties at 38°C measured on a Fann 6 speed rheometer:

Apparent viscosity	80.5 cP
Yield point	11 pa (23 lb/100 sq.ft.)
Plastic viscosity	69 cP
Gel strengths	2.4/2.9 (5/6 lb/100 sq.ft.)

The above values demonstrate the formation of a fluid emulsion suitable for drilling purposes.

CLAIMS

1. A drilling mud system which comprises a water soluble glycol ether, brine phase and surfactant content in which the brine strength is sufficient to prevent solvation of the glycol ether and surfactant is used to produce an emulsion in which the brine content is emulsified into the external ether phase.

2. A drilling fluid according to claim 1 in which the ether/water ratio may vary from 30/70 to 95/5 by volume.

3. A drilling fluid according to claims 1 or 2 in which the brine content is calcium chloride, sodium chloride or other soluble salt at a concentration of 5% or more of the brine.

4. A drilling fluid according to claims 1-3 in which the glycol ether is soluble at room temperature in fresh water and sea water.

5. A drilling fluid according to claims 1-4 in which there are present gelling aids such as clay or modified organoclays.

6. A drilling fluid according to claims 1-5 in which a weighting agent such as barite may be present.

7. A drilling fluid according to claims 1-6 in which there are present minor proportions of treatment additives required to control fluid loss and viscosity.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number 9103834.9

Relevant Technical fields

(i) UK Cl (Edition K) E1F (FGP)

(ii) Int Cl (Edition 5) C09K

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

D B Pepper

Date of Search

3 May 1991

Documents considered relevant following a search in respect of claims 1-7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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